

The aphids (Hemiptera: Aphididae) on Campanulaceae in Poland

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ABSTRACT. The paper deals with the relationships of aphids and their host-plants of the family Campanulaceae (bellflower family). The survey was conducted in xerothermic habitats during the years 2008-2010. A total of 84 plots were examined in the western, southern and eastern parts of Poland. The aphids were collected in 28 plots (42 records). As a result, 4 aphid species feeding on 6 different host plants of Campanulaceae were confirmed.

KEY WORDS: Aphidomorpha, aphids, bellflower family, host plants, dry habitats.

INTRODUCTION

In comparison with other hemipterans, with the exception of the Coccoomorpha, the aphids (Aphidomorpha) have the strongest relationships with their host plants. The vast majority (about 80%) of aphid species are monophagous or narrowly specialized oligophagous insects, closely related to a single genus or even a single species of host-plant, or with a few genera of plants from the same botanical family. The remaining aphids are polyphagous, unassociated with any particular group of host plants (OSIADACZ & HAŁAJ 2009). A large number of aphid species are associated with various angiosperms, among which the majority of plant families have their specific aphid faunas (HOLMAN 2009). The family Campanulaceae (Magnoliopsida, Asterales) also has its characteristic aphid assemblages.

Among the 741 aphid taxa recorded in Poland (OSIADACZ & HAŁAJ 2010, JUNKIERT et al. 2011), only 6 have been reported from various plants of the Campanulaceae family (OSIADACZ & HAŁAJ 2010). The Campanulaceae are one of the youngest and more

advanced dicotyledonous plant families, strongly diversified and widespread in various habitats throughout the world. There are about 2000 species of Campanulaceae, classified into 90 genera (WATSON & DALLWITZ 1992). The Campanulaceae of natural habitats in Poland comprise 23 species from 5 genera (MIREK et al. 2002). Besides wild plants, there are also a number of cultivated species, varieties, and their hybrids. The aphids strictly associated with this plant family (monophagous or narrowly oligophagous) are represented by only 5 species: *Aphis psammophila* SZELEGIEWICZ, 1967, *Dysaphis (Pomaphis) sorbi* (KALTENBACH, 1843), *Uroleucon (Uromelan) campanulae campanulae* (KALTENBACH, 1843), *U. (U.) nigrocampanulae* (THEOBALD, 1928), *U. (U.) rapunculoidis* (BÖRNER, 1939). In addition, the polyphagous *Aphis fabae* SCOPOLI, 1763 has also been recorded from various plants of the Campanulaceae family.

Very little research has been done on the co-evolutionary and phylogenetic aspects of the trophic relationships between aphids and their host-plants (HOLMAN 1981, 1998, OSIADACZ & WOJCIECHOWSKI 2005, 2008, SHAPOSHNIKOV 1985, STEKOLSHCHIKOV 2008, WĘGIEREK & WĘGIEREK 2003). There are hardly any surveys dealing with relationships between aphids on particular Campanulaceae. Aphids are widely known as pests and vectors of various plant pathogens. On the other hand, their importance in natural and semi-natural communities, as foodsources for predators and parasitoids and as producers of honeydew is underestimated or ignored (OSIADACZ & HALAJ 2009).

The main aim of this work is to describe the aphids associated with the Campanulaceae (bellflower family) in Poland. Large-scale research on the aphid fauna of rare and endangered plant assemblages of Poland has yielded new data on relationships between aphids and bellflowers. A better understanding of the relationships among organisms will ensue from properly carried out nature management and biodiversity protection. Understanding the relations between aphids, their host-plants and habitats, as well as the relationships among organisms in various natural and semi-natural habitats are some of the crucial points.

MATERIAL AND METHODS

The research was carried out in 2008-2010 in xerothermic plant communities of the class *Festuco-Brometea* (78 plots), psammophilous grasslands of the alliance *Koelerio glaucae-Corynephorretum* (4 plots) and calamine grasslands of the class *Violetalia calaminariae* (2 plots).

A total of 84 plots were examined, located in 25 physico-geographical mesoregions (KONDRACKI 2002) (Fig. 1): Chełm (1 plot); Dolina Środkowej Noteci (5), Działy Grabowieckie (4), Garb Tarnogórski (13), Garb Tenczyński (1), Gorce (1), Góry Świętokrzyskie (5), Grzęda Sokalska (3), Kotlina Gorzowska (2), Kotlina Toruńska (1),

Nizina Śląska (1), Pagóry Chełmskie (2), Pagóry Jaworznickie (9), Pieniny (4), Podgórze Rzeszowskie (2), Pogórze Szydłowskie (1), Pojezierze Krajeńskie (1), Pojezierze Łagowskie (1), Przełom Bugu (6), Roztocze Środkowe (1), Roztocze Wschodnie (1), Wyniosłość Giełczewska (1), Wyżyna Częstochowska (10), Wyżyna Miechowska (7), Wyżyna Olkuska (1).

The voucher materials in the form of microscope slides have been temporarily deposited at the Department of Environmental Protection, University of Life Sciences, Poznań.



Fig. 1. Distribution of research sites in Poland: 1 – Campanulaceae-related aphids not recorded; 2 Campanulaceae-related aphids recorded.

RESULTS

Despite the fact that at least single specimens of various Campanulaceae were present in all 84 plots examined, aphids associated with this plant family were found in only 28 of the plots (Fig. 1). 4 species of aphids were present on 6 species of Campanulaceae host-plants (*Campanula cervicaria* L., *C. rapunculoides* L., *C. rotundifolia* L., *C. sibirica* L., *C. trachelium* L. and *Jasione montana* L.). There were 42 aphid records.

***Aphis (Aphis) psammophila* SZELEGIEWICZ, 1967**

Aphids green to dark green, living on the subterranean parts of *Jasione montana* and *Campanula* spp., always attended by ants. A holocyclic, monoecious, typically xerophilous species, with a European distribution (Southern and Central Europe). In Poland, recorded on the Baltic Sea Coast, the Kraków-Wieluń Upland and Małopolska Upland. Before 1968 also known from the Masurian Lake District, Wielkopolsko-Kujawska Lowland and Mazovian Lowland (OSIADACZ & HAŁAJ 2009). Apart from Poland this species is found in Bulgaria, the Czech Republic, Denmark, France, Germany, the Netherlands, Slovakia, Spain and the Balkan countries (NIETO NAFRIA et al. 2010).

Localities (Fig. 2). Przełom Bugu: Mielnik-Kopalnia Kredy (UTM: FD30), 08 VII 2010, *Jasione montana* L.; Wyżyna Częstochowska: Podlesice (UTM: CB90), 16 VII 2009, *Jasione montana* L.; Grochowiec Wielki (UTM: CA98), 23 VII 2009, *Jasione montana* L.; Wyżyna Olkuska: Rabsztyn (UTM: DA07), 25 VI 2009, *Jasione montana* L.

***Uroleucon (Uromelan) campanulae campanulae* (KALTENBACH, 1843)**

Aphids reddish-brown to black, shiny, living on the upper parts of stems and flowers of *Campanula* spp. and *Jasione* spp. Reported as a vector of viruses. A holocyclic, monoecious, xerophilous species, with a Western Palearctic-steppe distribution. Recorded in Poland on the Baltic Sea Coast, in the Wielkopolsko-Kujawska Lowland, Kraków-Wieluń Upland, Małopolska Upland, Sandomierz Lowland, Western Sudetes Mountains and Bieszczady Mountains. Before 1968 also recorded in the Pomeranian Lake District, Masurian Lake District, Mazovian Lowland and Lublin Upland (OSIADACZ & HAŁAJ 2009). According to "Fauna Europaea", known only from Poland and Italy (NIETO NAFRIA et al. 2010). But HOLMAN (2009) states this species as also being present in Austria, Belgium, the Czech Republic, Estonia, Germany, Denmark, Finland, France, Hungary, the Netherlands, Norway, Romania, Slovakia, Slovenia, Sweden, Ukraine and the United Kingdom.

Localities (Fig. 3). Garb Tarnogórski: Pleszczotka (UTM: CA97), 15 VII 2010, *Campanula rapunculoides* L.; Pieniny: Biała Woda (UTM: DV67), 24 VII 2010, *Campanula rotundifolia* L., Pieniński Park Narodowy-Czorsztyn (UTM: DV57), 29 VI 2009, *Campanula rapunculoides* L.; Roztocze Wschodnie: Dziewięcierz (UTM: FA76), 05 VII 2010, *Jasione montana* L.; Wyżyna Częstochowska: Apteka (UTM: CB90), 27 VII 2008, *Campanula rotundifolia* L., Biblioteka (UTM: CB90), 25 VII 2008, 27 VII 2009, 18 VI 2009, 18 VI 2009, 16 VII 2009, *Campanula rotundifolia* L., Podlesice (UTM: CB90), 02 VIII 2008, 16 VII 2009, *Campanula rotundifolia* L., Skały Rzędkowickie (UTM: CB90), 16 VII 2009, *Campanula rotundifolia* L.; Wyżyna Olkuska: Rabsztyn (UTM: DA07), 25 VI 2009, *Jasione montana* L.

Uroleucon (Uromelan) nigrocampanulae (THEOBALD, 1928)

Aphids dark brown, living on the underside of leaves and upper parts of stems of *Campanula* spp. This species may cause leaves to roll up in spring, and their subsequent yellowing. A holocyclic, monoecious, mesohygrophilous species, with a Western Palearctic distribution (Europe, Asia to the East Siberia). In Poland recorded in the Wielkopolsko-Kujawska Lowland, Lower Silesia, Upper Silesia, Kraków-Wieluń Upland, Małopolska Upland, Sandomierz Lowland, Western Sudetes and Western Beskids. Before 1968 also reported from the Masurian Lake District and the Orawa-Nowy Targ valley (OSIADACZ & HAŁAJ 2009). Apart from Poland, it is also known from Austria, Belarus, Belgium, Bulgaria, the Czech Republic, Denmark, Estonia, Finland, Germany, Hungary, Italy, Lithuania, Moldova, north-west Russia, Romania, Slovakia, Spain, Sweden, Ukraine and the United Kingdom (NIETO NAFRIA et al. 2010).

Localities (Fig. 4). Grzęda Sokalska: Ruda Żurawiecka (UTM: FA88), 05 VII 2010, *Campanula sibirica* L.; Góry Świętokrzyskie: Chęciny (UTM: DB62), 11 VII 2009, *Campanula sibirica* L., Miedzianka (UTM: DB53), 11 VII 2009, *Campanula sibirica* L.; Pogórze Szydłowskie: Sobków (UTM: DB61), 11 VII 2009, *Campanula sibirica* L.; Wyniosłość Giełczewska: Bychawa (UTM: FB05), 09 VII 2010, *Campanula sibirica* L.; Wyżyna Częstochowska: Dobra (UTM: DA09), 01 VIII 2010, *Campanula sibirica* L., Skały Rzędkowickie (UTM: CB90), 16 VII 2009, *Campanula trachelium* L.; Wyżyna Miechowska: Dale (UTM: DA47), 08 VIII 2009, 11 VII 2010, *Campanula sibirica* L., Kalina Lisiniec (UTM: DA47), 19 VII 2008, 11 VII 2010, *Campanula sibirica* L., Klonów (UTM: DA47), 19 VII 2008, *Campanula sibirica* L., Komorów (UTM: DA37), 11 VII 2010, *Campanula sibirica* L.

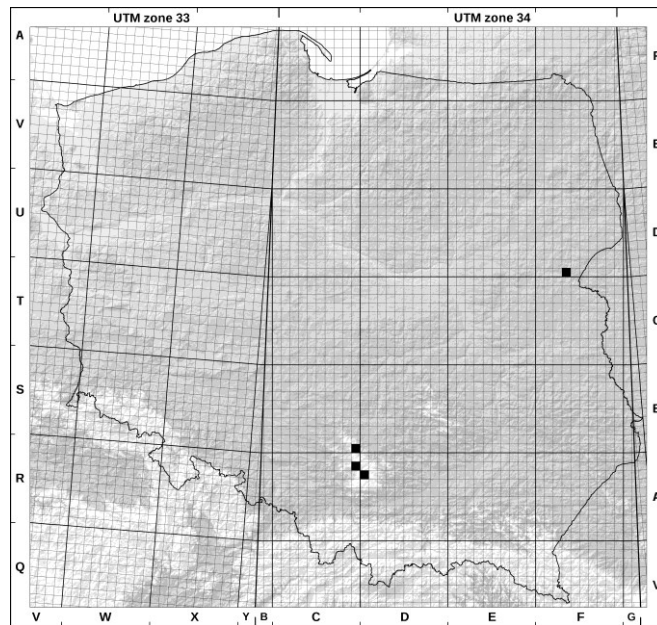


Fig. 2. Localities of *Aphis psammophila* in Poland.

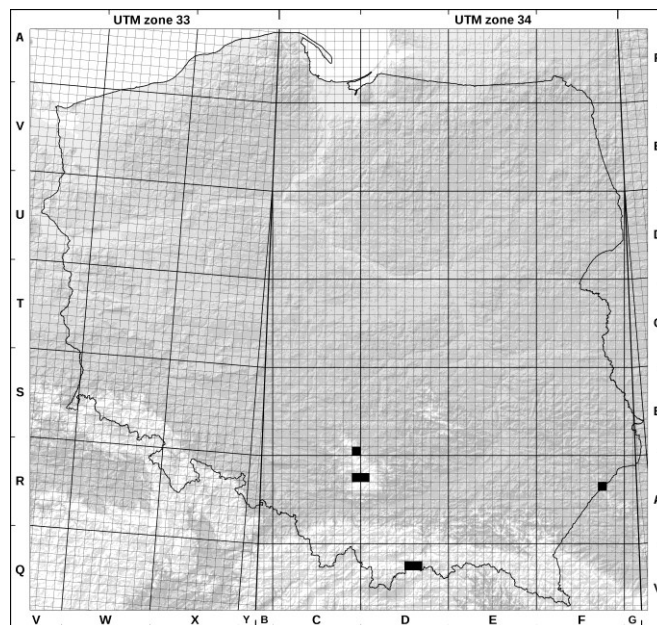


Fig. 3. Localities of *Uroleucon campanulae campanulae* in Poland.

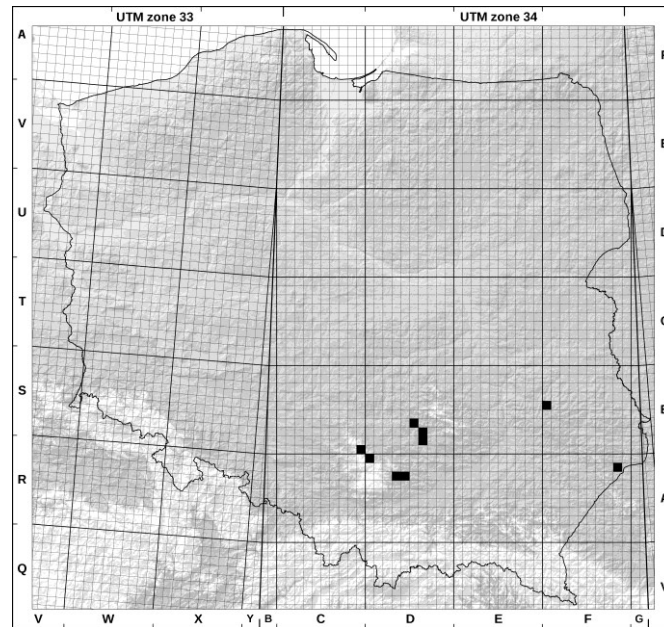


Fig. 4. Localities of *Uroleucon nigrocampanulae* in Poland.

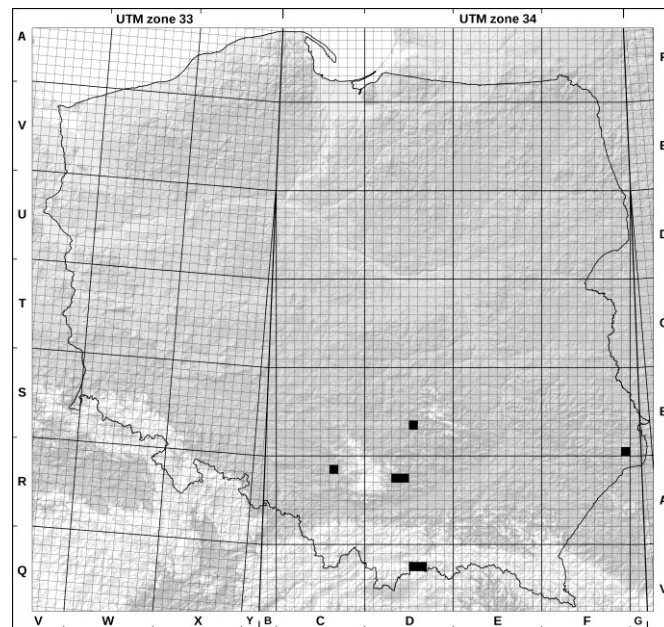


Fig. 5. Localities of *Uroleucon rapunculoidis* in Poland.

Uroleucon (Uromelan) rapunculoidis (BÖRNER, 1939)

Aphids dark brown, shiny, living on the undersides of leaves, the upper parts of the stems and flowers of *Campanula* spp. (mostly *C. rapunculoides*). They cause frequent deformations of the leaves. Recorded as a vector of viruses. A holocyclic, monoecious, xerophilous species with a Western Palaearctic-steppe distribution (Europe, South-Western and Central Asia). In Poland recorded only in the Kraków-Wieluń Upland. Before 1968 also known from the Masurian Lake District (OSIADACZ & HAŁAJ 2009). Data from the Wielkopolsko-Kujawska Lowland (ACHREMOWICZ 1967, SZELEGIEWICZ 1968) are dubious, and because of lack of voucher specimens, impossible to verify (OSIADACZ & HAŁAJ 2011). Apart from Poland, known from Austria, the Czech Republic, Denmark, France, Germany, Italy, Lithuania, the Netherlands, Romania, Slovakia, Sweden, Ukraine, Kazakhstan and the Middle East (HOLMAN 2009, NIETO NAFRIA et al. 2010).

Localities (Fig. 5). Garb Tarnogórski: Dziewicza Góra (UTM: CA68), 01 VII 2010, *Campanula rapunculoides* L., Strzyżowice (UTM: CA68), 13 VII 2010, *Campanula rapunculoides* L.; Góry Świętokrzyskie: Miedzianka (UTM: DB53), 26 VII 2008, *Campanula rapunculoides* L.; Grzęda Sokalska: Dobużek (UTM: FB90), 06 VII 2010, *Campanula sibirica* L.; Pieniny: Pieniński Park Narodowy-Zawiasy (UTM: DV57), 17 VII 2008, 22 VII 2010, *Campanula rapunculoides* L., Wąwóz Homole (UTM: DV67), 30 VI 2009, 24 VII 2010 *Campanula rapunculoides* L., 30 VI 2009, *Campanula trachelium* L.; Wyżyna Miechowska: Kalina Lisiniec (UTM: DA47), 19 VII 2008, *Campanula rapunculoides* L., Komorów (UTM: DA37), 11 VII 2010, *Campanula cervicaria* L. [this species is new host plant of *U. rapunculoidis* (OSIADACZ & HAŁAJ 2011)].

COMMENTS

As mentioned, regardless of the high diversity of plant species of Campanulaceae, they are colonized by only a limited number of aphids. Worldwide, there are only a dozen or so species or subspecies of monophagous or narrowly oligophagous aphids associated with the bellflower family (BLACKMAN & EASTOP 2006). This observation is very interesting, as in the closely related plants of the family Asteraceae (SOLTIS et al. 2005) (Fig. 6), in Poland alone some 150 species of aphids have been reported from various genera (OSIADACZ & WOJCIECHOWSKI 2005). Besides species from the genera *Aphis* and *Uroleucon* (not only the subgenus *Uromelan*, but also the nominative subgenera *Uroleucon* MORDVILKO, 1914, and *Lambersius* OLIVE, 1965), there are also aphids from other genera. Of the family Aphididae, 5 genera of Aphidini and 14 genera of Macrosiphini feed on Asteraceae. In comparison, of the family Lachnidae HERRICH-SCHAEFFER in KOCH, 1854, 3 genera of

Tramini HERRICH-SCHAEFFER, 1854 were reported from Asteraceae (OSIADACZ & HALAJ 2010). In these cases we can assume the “mutual adjustment” (possibly co-evolution?) of two phylogenetically relatively young groups: the Asteraceae family and aphids of the families Aphididae and Lachnidae (CZYŁOK 1990, HEIE 1987) (Fig. 7). The mystery is therefore why this process is not so common in the case of aphids and Campanulaceae.

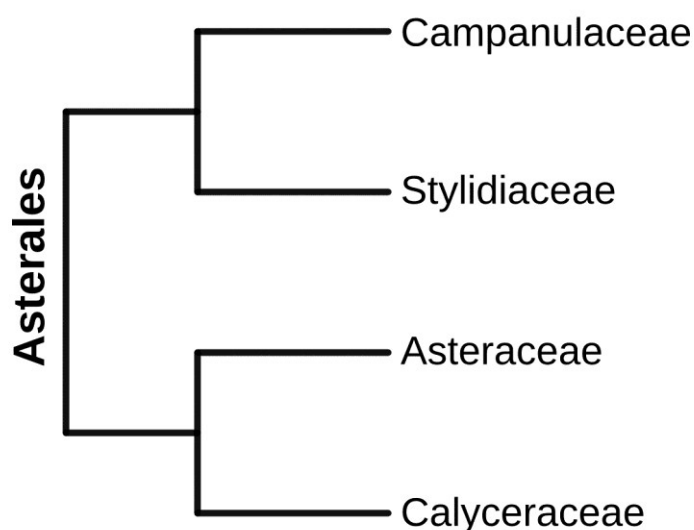


Fig. 6. Phylogenetic tree of Asterales (according to SOLTIS et al. 2005).

It can be assumed that this small number of aphid species feeding on Campanulaceae is not due to the biochemical nature of the plants (their milky sap is not toxic). It seems that the answer is rather in the habitat relationships of the plants: the vast majority of Campanulaceae grow in dry habitats. These are xerothermic grasslands and swards, psammophilous grasslands, and some marginal habitats. Most such habitats are fragmentary, dispersed and declining in the landscapes of Poland and other countries. Xerothermic ecosystems, though common in southern and eastern Poland, are regarded as endangered both in Poland and in Europe: they are covered by ‘Habitat Directive’ 92/43/EWG (DYREKTYWA 1992) and an Act on Nature Protection (USTAWA 2009). The important fact seems to be that Campanulaceae grow in such habitats. Unlike the Asteraceae, the degree of “coverage” is rather low: they grow separately, and with exception of *Jasione montana* and *Campanula persica*, seldom in aggregations. Therefore, it could well be that it is not just the availability of food resources

that to a high degree limits the number of known aphid species associated with the Campanulaceae (see results), but also their speciation processes, for which some evidence is forthcoming (BARBAGALLO & PATTI 1994).

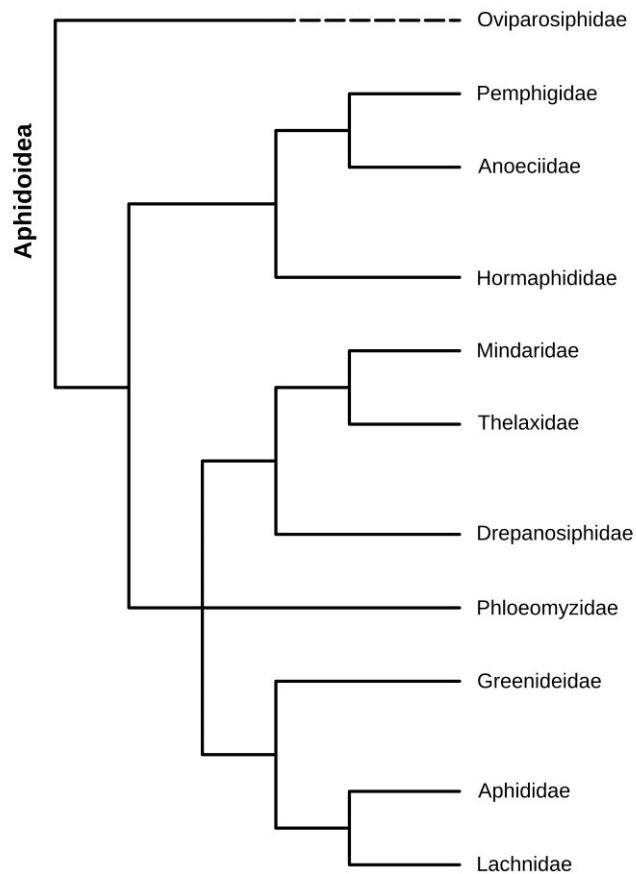


Fig. 7. Relationships among Aphidoidea families (according to HEIE 1987).

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